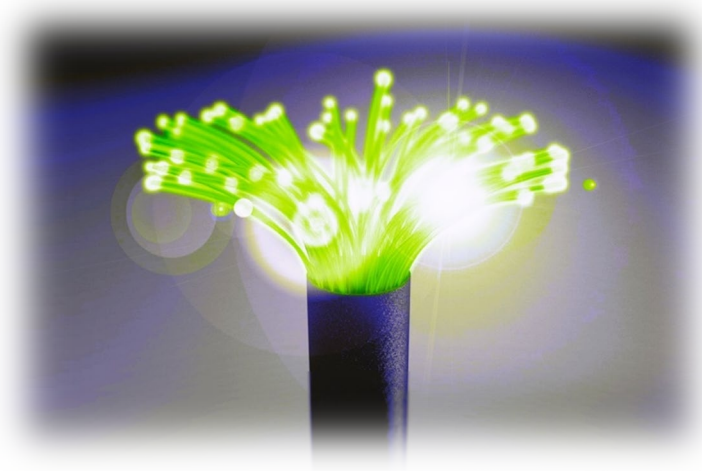




Fort Bragg

Digital Infrastructure Project

*An Approach to Implement High-Speed Internet for
The City of Fort Bragg*



FORT BRAGG
CALIFORNIA

August 2021

TABLE OF CONTENTS

EXECUTIVE SUMMARY	3
PROJECT OVERVIEW	4
INTRODUCTION	5
IMPLEMENTATION OF THE DIGITAL INFRASTRUCTURE PLAN	5
PROJECT PLANNING ASSUMPTIONS	5
BROADBAND NETWORK OVERVIEW	6
OVERVIEW OF THE NETWORK ARCHITECTURE	6
PROJECT DESCRIPTION	9
DESKTOP MANAGEMENT AND DESIGN, COST, AND DEPLOYMENT SCHEDULE	9
DESIGN AND BUILD METHODOLOGY	10
OSP DESIGN RESULTS	13
DESIGN AND DISTRIBUTION AREAS:	13
CONDUIT FOOTAGE:	14
PASSIVE MATERIALS:	15
FIBER SIZES:	16
ELECTRONICS DESIGN	17
CORE ROUTING:	18
OPTICAL LINE TERMINATION:	18
OPTICAL NETWORK TERMINATION:	19
DATA CENTER:	20
SUBSCRIBER ACQUISITION (DROPS AND CPE EQUIPMENT):	22
PROJECT MANAGEMENT:	23
CONSTRUCTION SCHEDULE	25
NETWORK OPERATOR/SERVICE PROVIDER DEFINED	26
PRO-FORMA	28
REVENUE ASSUMPTIONS (60% TAKE RATE)	29
EXPENSE ASSUMPTIONS (60% TAKE RATE)	29
10-YEAR INCOME STATEMENT:	31
10-YEAR CASH FLOW STATEMENT:	32
10-YEAR BALANCE SHEET STATEMENT	33
APPENDIX	35
RECOMMENDED VENDORS TO USE FOLLOWING DECISION TO PROCEED:	35
FUTURE TECHNOLOGIES	35
RESPONSIBILITY MATRIX	36

EXECUTIVE SUMMARY

The purpose of this document is to provide the City of Fort Bragg (city) with a high-level overview of a Digital Infrastructure Plan which includes desktop design and estimated build costs for a Fiber to the Premise (FTTP) broadband deployment project, as well as a potential path for operating and servicing customers over the network. The resulting project information will allow city to make an informed decision on the next steps in providing Fort Bragg with a digital infrastructure (underground conduit, fiber, and electronics) and to provide high-speed internet service to residences/businesses within the City Limits of Fort Bragg with a resilient and future proof underground fiber-optic based network capable of serving residences, businesses, and anchor institution.

An assessment of the broadband availability found there are four primary Internet service providers in Fort Bragg providing service over fiber optic cable, cable TV (Radio Frequency cable) systems, copper DSL, fixed wireless, dial-up, and satellite internet. The two largest providers of fiber-based Internet services are AT&T and Comcast, mostly in the more business concentrated areas in the city. Sonic has recently come into Mendocino, offering high-speed Internet services using AT&T Unbundled Network Elements (UNE), i.e., aged AT&T copper pair infrastructure. In addition to these three providers, several smaller fixed wireless Internet service providers, including North Coast Internet, and Mendocino Community Network (MCN); however, these providers cannot scale a robust high-speed network like fiber optic cable delivered systems. It is public knowledge that Fort Bragg consumers are unhappy with current high-speed Internet providers, both from speed and service issues, and little can be done to motivate incumbent carriers to address the issues by deploying underground fiber infrastructure.

Fort Bragg needs a Digital Infrastructure Plan that positions city to control their own destiny, especially with forthcoming technologies expected in the next few years, all of which require greater bandwidth than what traditional service provider technology can generate. This plan calls for the funding and construction of a fiber-to-the-premise (FTTP) network. It is planned that customers will be able to obtain fiber-based technology with speeds up to 10 Gbps at or near current incumbent pricing. This plan also identifies MCN as the service provider who is fully capable of providing service, this eliminating the need for the city to become an ISP. MCN and the City will negotiate wholesale and retail pricing once detailed engineering is completed, total cost is determined, and funding sources identified.

The result of this analysis demonstrates the cost of owning a fiber network capable of providing much needed affordable broadband services to its residence and business customers, and can do so without the risks associated with starting up an ISP; MCN will do that for the city.

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

PROJECT OVERVIEW

PROJECT OVERVIEW

Management and Design: City Smart Consulting (CSC) and its partners have planned, and performed a desktop-designed project for implementation, as part of the ***City of Fort Bragg Digital Infrastructure Plan 2021-2025***. The CSC team collaborated with PalniES Engineering, Walker and Associates, ADTRAN, and Juniper to design the project for next steps implementation. Additionally, CSC coordinated and received feedback from MCN, who is being considered as the service provider responsible to manage and operate the end-user customer under a service agreement with the city.

Targeted Households/Businesses: The project in the ***City of Fort Bragg*** is targeted to reach approximately 4000 homes/business addresses within the city limits. Specifically, residences comprise 3100 households, while businesses comprise 900 locations. Residence and businesses represent 2654 structures; some structures like MDU's and Multi-tenant businesses share a single building structure.

Network Architecture: The approach is to bring between to 1 – 10 Gbps Internet connectivity and voice service to all homes, businesses, towers, and anchor institutions in the community areas via a robust underground fiber-based last-mile fiber distribution system. The projects have three infrastructure components – 1) Last-Mile Distribution Systems, 2) Data Center Electronics, and 3) Fiber to the Premise Drops

Estimated Capital Cost: The estimated cost to implement all three Components is **\$12,156,845**

Deployment Schedules: The deployment schedule for this project with an assumed construction start date of June 2022 and a final completion date of June 2025 or a total of 36 months from start to finish. The base infrastructure passing homes should take 20 weeks or less, while drops to be placed upon service request and will be ongoing until a service drop reaches all locations estimated in 2025.

INTRODUCTION

IMPLEMENTATION OF THE DIGITAL INFRASTRUCTURE PLAN

Recommended stated goal of the **City of Fort Bragg** is to:

“Provide a digital infrastructure for affordable high-speed Internet access for 100% of households and businesses by 2025.”

High-speed Internet, for the purposes of this plan is defined as gigabit service (1-10 Gbps or higher). This is an ambitious goal, but critical for the economic future of Fort Bragg and through advancements in technology it is possible.

The **Plan** has three objectives:

- 1) Develop Projects to Deploy **Fiber Optic Cable** based technology to City of Fort Bragg
- 2) Create Policies that Local Government can Support to **Improve the Network and Facilitate Future Technologies**
- 3) Develop Projects that **Improve Resiliency and Redundancy** in Digital Infrastructure Systems

When this project is completed, nearly 3,100 households and 900 businesses will have broadband access at 21st century gigabit speeds. There will also be a technologically advanced, robust, and diverse fiber-based infrastructure around the city, as depicted on the maps included in this document.

PROJECT PLANNING ASSUMPTIONS

The following are the key assumptions that guided the team in developing the City of Fort Bragg, Digital Infrastructure Plan:

- One hundred (100%) percent of the households and businesses are to be connected via underground conduit and fiber installation. Underground fiber design is to preserve and “future proof” the infrastructure during severe storms, wildfires, and other unforeseen disasters. According to an assessment by Magellan Advisors for Napa County, 30 percent of the telecommunications infrastructure was damaged by the 2017 wildfires. The underground infrastructure was not damaged.¹
- Project will use Internet backhaul provided by AT&T to connect end-users with the world-wide Internet; AT&T is the only provider for this service at this time. There are other

¹ <http://www.mendocinobroadband.org/wp-content/uploads/Napa-County-Fiber-Infrastructure-Engineering-Assessment-Report.pdf>

efforts underway that could provide other backhaul choices soon. The State of California is pursuing a state-wide Open-Access middle-mile project.

- The fiber optic cable approach in this project is to provide capabilities up to 10 Gbps Internet connectivity to all households, large and small businesses, anchor institutions, and other institutions in the community areas, via a robust underground fiber optic cable network. Additionally, this network can provide Internet backhaul for WISP's and Cellular providers that wish to utilize network. The network will be available for any provider who desires to have fiber connectivity.
- The host Data Center will be located 416 N. Franklin Street, in Fort Bragg and will be equipped with Juniper Routers, ADTRAN Optical Line Terminal (OLT) XGSPON 10 Gig line cards, Fiber-optic patch panels, local 32:1 splitter, backup power, HVAC, and fire suppression equipment. This location already has a sufficient backup generator in the event of prolonged power outages. The location will have diverse dual entrance conduits connected to AT&T backhaul services.
- Cost estimates are based upon desk-top design; prior to moving forward the city will need to perform detailed engineering and obtain firm quotes following city construction and procurement policies.
- MCN is the service provider; the city provides fiber optic cable infrastructure and electronic equipment only, while MCN markets, sells, provisions, bills, and repairs customers (service activation and service assurance).
- MCN will pay a wholesale fee to the city for use of the fiber infrastructure.
- Network to be designed as future proof to facilitate growth and future technological advancements.

BROADBAND NETWORK OVERVIEW

OVERVIEW OF THE NETWORK ARCHITECTURE

The approach is for MCN to offer up to 10 Gbps Internet connectivity to all homes, businesses, towers, and other institutions in the community areas via a robust underground last-mile fiber distribution system. The city will design & engineer, build, and operate the entire network infrastructure by providing all the necessary equipment to light the last-mile network (city is network owner). MCN will serve as the service provider with the primary goal to provide a reliable high-speed Internet network service to all potential users in the community at a competitive price, encouraging economic development, and providing excellent customer service. The city will monitor MCN service results via a Subscriber Service Level Agreement (SLA) to ensure service meets or exceeds user expectations.

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

Through partners (fiber cable manufacturers, electronic equipment providers), the infrastructure owner/provider (city) will detail design and build the network utilizing a passive optical network design for residential and small business, and some active Ethernet (dedicated fibers from data center to their location) for larger businesses. City will utilize this approach to create a state-of-the-art network design with the future in mind.

The plan for in the city is to have a centralized data center located at 416 N. Franklin St, that will host Internet electronics equipment that connects with nine XGS-PON splitter cabinets located throughout the city. The data center will be supplied with Core Routing, Edge routing, and Optical Line Terminal equipment (OLT). The data center will have eight-hours back-up power via batteries and will further be supported by an existing backup generator in the event of prolonged power outage.

Nine distribution areas (DA's) will be designed with passive splitter cabinets that will be placed throughout the community. The distributed cabinets will be based upon the size of the distribution area and distance reach of optical port cards. In each location, there will be an above ground passive XGS-PON cabinets². These locations we will serve as the aggregated fiber locations where conduit, fiber cable, and fiber distribution terminals serving each home/business will be fed from. The cabinets will look similar to what incumbent providers already have within the city ROW.

At each end-user location, construction crews will place underground conduit and fiber drop wire connected from the fiber service terminal (FST) to a connection point at each location at or near current utility entrance point (demark); this completes the fiber infrastructure owned by the city.

Upon service request, MSN will arrive at the home/business and place the ONT device (fiber termination). Once fiber is located at the side of the structure the demark location has been established. MCN will perform service installation by installing in-building fiber cable from the demark location inside the home or business. During the installation process, MCN will place an integrated optical network termination device (ONT) with four ethernet ports, a voice service port, and indoor Wi-Fi 6 capabilities.

For larger businesses, city will provision a dark or lit fiber service using traditional industry interconnection equipment (small router). The city will terminate fiber at the main point of entry (MPOE), MCN will work with customer on inside wire design and installation.

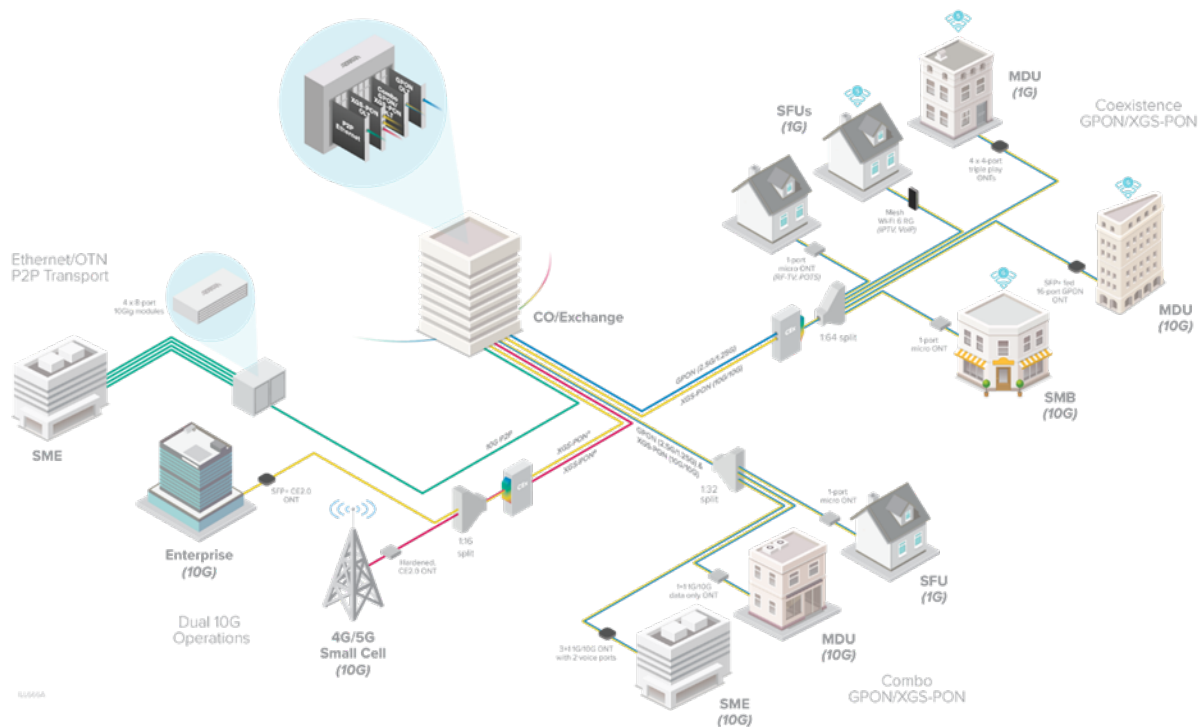
Internet peering and voice service including diverse 911 path to Mendocino County PSAP is planned to be from primary network data center. The city along with MCN will install fiber and routing equipment that will provide much needed diverse routing ensuring diversity for 911-service as well as internet backhaul. Infrastructure to be placed between data center and MCN data center to allow network interconnection. MCN performs these functions today for their existing customers.

² The passive cabinets do not require power as there are no electronics, just fiber splitters.

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

AT&T is the only carrier that can provide Internet backhaul capacity, as a result the city and MCN would build in as much diversity as possible until other options are available; this is the current situation in Fort Bragg. As new long-haul options become available MCN will provide much needed diversity for this important component of the project. Backhaul providers will be chosen by and paid for by MCN through an open quote process (even though it is AT&T network) Backhaul circuits to be activated once the network nears completion; pricing varies greatly and is expected to be lower as time goes on. Internet backhaul is designed to be reliable, with improved performance. MCN understands how to manage backhaul and have been doing it for years. See Figure 1 – Basic Industry High-level Network Architecture.

Figure 1: Basic Industry High-Level Network Architecture (Cite: Walker and Associates)

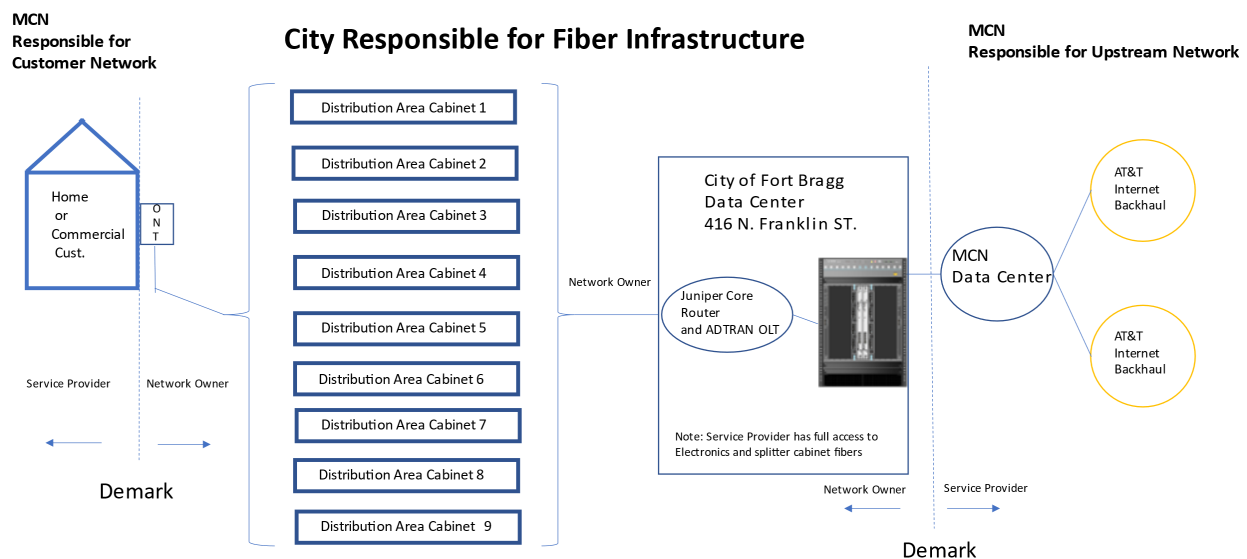


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The Fort Bragg specific network architecture is based upon the same design concepts found in existing, larger city designs. Below is the proposed network architecture and design for the City of Fort Bragg. This architecture is easily expanded for future growth of the city. See Figure 2 City of Fort Bragg Network Architecture. You will note the separation of responsibilities between the city and MCN. A responsibility matrix has been discussed between MCN and the city with agreed upon demark locations.

Figure 2: City of Fort Bragg Network Architecture

City of Fort Bragg - Network Architecture



PROJECT DESCRIPTION

DESKTOP MANAGEMENT AND DESIGN, COST, AND DEPLOYMENT SCHEDULE

Management and Design: CSC collaborated with vendor community to perform a desktop design to arrive at estimates, as part of the *City of Fort Bragg Infrastructure Plan: 2021-2025*,

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

CSC also collaborated with MCN as they are targeted to become the service provider; service provider must have a say in the design so they can efficiently operate and provide the levels of service they provide.

Estimated Cost: The City of Fort Bragg project is estimated to cost **\$12,156,845** to implement. The capital expenses are defined as: 1) detailed engineering, 2) last-mile distribution system, 2) electronics, 3) fiber to the premise drops, and 4) project management. It is recommended the city (infrastructure owner) build the electronics and last-mile distribution and then have MCN turn up service, while fiber to the home drops can be deployed when request for service activation occurs. The total cost breakdown for 100% of the locations is as follows: last-mile distribution - **\$6,980,475**, electronics and data center equipment preparation - **\$738,123** fiber to the premise drops - **\$4,082,478**, and project management - **\$355,769**.

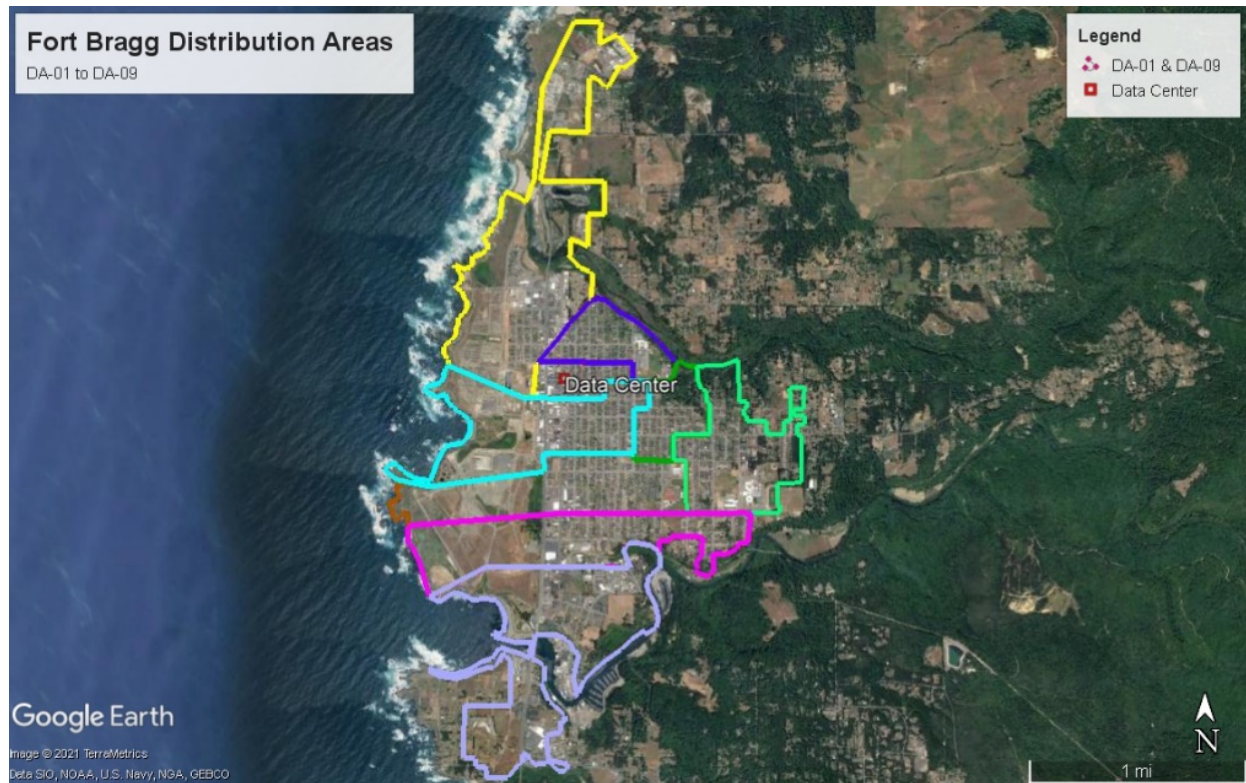
Deployment Schedule: The build out schedule is dependent upon a few factors of which some, but not all, are the results from detailed engineering, material availability, construction crew availability, permits, and weather. Expect timing to be determined based upon funding availability from the city. Construction work should follow an “inside-out” strategy, working from downtown area (data center) towards the outlying areas, and based upon construction crew productivity. As segments are completed, crews will focus on “optical fiber cable drops” to the homes, businesses, and anchor institutions. A separate “drops crew” will follow “construction crew” installing drops from distribution cables, and a separate crew provided by MCN completing premise wiring and turning-up service; this service activation process is dependent upon and managed through the service activation process. Due to size of this project, expect to complete electronics/data center, and last-mile distribution system in 20 weeks, while drops will be an ongoing process until all premises are connected. The deployment schedule assumed a start date of June 2022 and a completion date of June 2025 or a total of 36 months from start to finish, including the time to process all necessary permits.

DESIGN AND BUILD METHODOLOGY

The methodology used by the team was to first gather pertinent information, such as number of residence and business location counts, city limit boundary, street maps, location of main electronics hub (data center), and type of network to be designed (XGS-PON with 32:1 split) for the Outside Plant (OSP) portion. This data was then placed into Google Earth Pro, the design tool used to derive footages. Design engineers then broke the city into manageable and technically feasible parts, titled distribution areas (DA's), see Figure 3.

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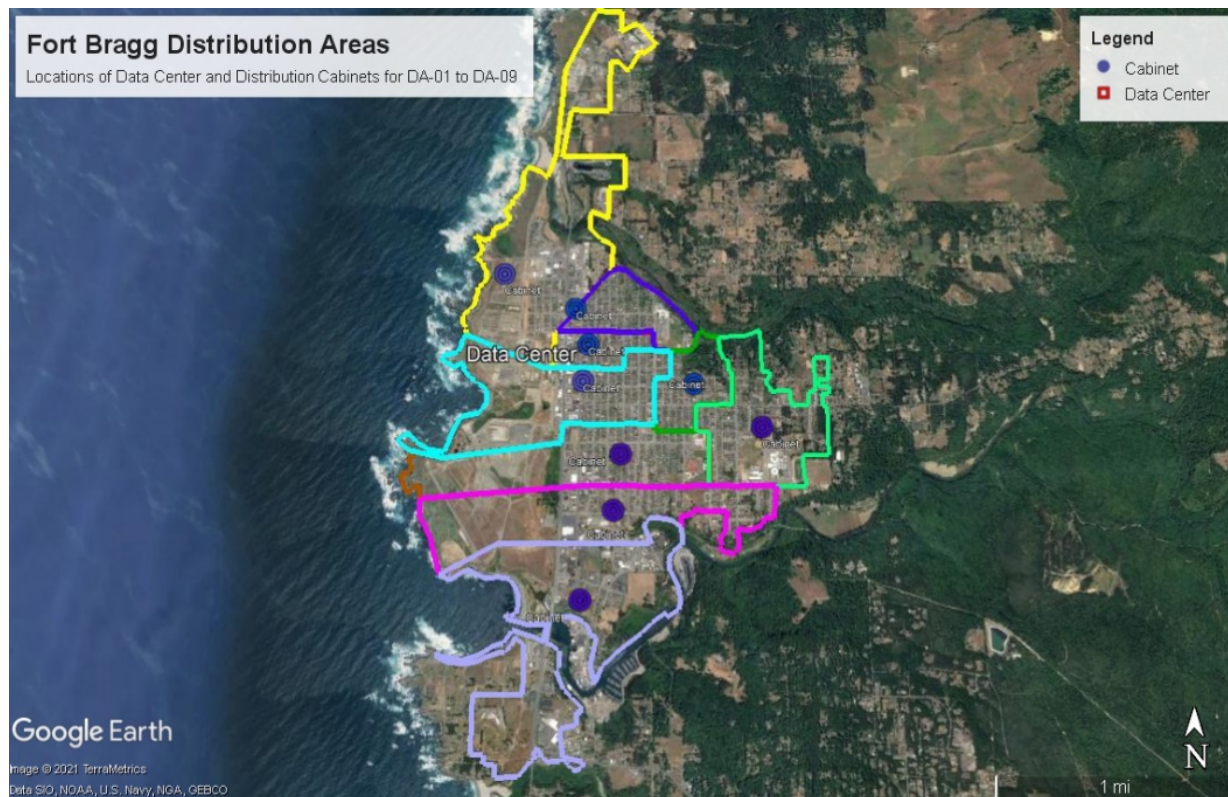
Figure 3 – City of Fort Bragg Distribution Areas



In total nine passive cabinets would be placed in each of the DA's. These nine DA cabinets sized for potential 864 customers each to facilitate future growth, will have a conduit and fiber back to the Data Center, and will house the 32:1 splitter tray's (1 fiber for every 32 customers) that connect individual locations (res/bus). See Figure 4 – Fort Bragg Distribution Areas and Cabinets.

Figure 4 – City of Fort Bragg Distribution Areas and Cabinets

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)



Once the main design criteria were established, the team designed conduit layout down many of the streets/alleys ensuring ability to serve structures from either side of the street, or via the alley. Cable sizes and footages were factored into the design, as were fiber subscriber terminals (FST), splice locations, and tether locations. From FST a drop conduit and fiber were designed to each structure, see Figure 5 - Sample of Fort Bragg Design. This effort completes the optical lighted path from the DC to each structure.

Figure 5 – City of Fort Bragg Distribution Area Design Sample



OSP DESIGN RESULTS

DESIGN AND DISTRIBUTION AREAS:

The results of the design are listed in the following tables. The design results reveal total number of passive cabinets and their location, footage for conduit and fiber, which include an additional 10% for extra conduit and cable to address the unforeseen and provide fiber cable slack needed for restoration in the event of cable cuts. If a cable is severed, normally through heavy equipment damage, the slack loops allow technicians to pull slack from splice points and then re-splice cable. Additionally, the design included a list of known passive materials such as, passive cabinets, splice enclosures, hand-holes, splitters, fiber service terminals, drop wire and termination. In total the design identified 157,671.80 feet serving 2,654 structures. The structures include multi-business locations as well as Multi-Dwelling Units. Note the difference

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

between total address locations (potential customer counts) and structures (2,654) is a result of multiple service address at a single address. Once detailed engineering is completed expect to see a more accurate count of footage and material required. For the purpose of this high-level design the amounts should be considered as very accurate for this early phase of the project. See Table 1 – Distribution Areas and Cabinet Sizing and Location.

Table 1 – Distribution Area and Cabinet Sizing, and Location Per DA

Distribution Area and Cabinet Sizing and Location Per DA		
Distribution Area Design	Passings	Cabinet Location (V&H Coordinants)
DA-01	299	39.451748, -123.805705
DA-02	240	39.445609, -123.803831
DA-03	223	39.448146, -123.805130
DA-04	375	39.443062, -123.804286
DA-05	257	39.442897, -123.794394
DA-06	380	39.438152, -123.800944
DA-07	359	39.439956, -123.788732
DA-08	342	39.434479, -123.801572
DA-09	179	39.428814, -123.804295
Totals	2,654	

CONDUIT FOOTAGE:

City of Fort Bragg conduit footage includes the lengths required to place the base infrastructure which includes conduit down streets and alleys, as well as crossings necessary to jump from one side of the street to the other. In total, conduit necessary to complete the design is 157,671.80 feet. The design calls for two 2.5-inch conduits for base infrastructure completion of this project, and a third 2.5-inch conduit for future unknown needs. The unknown needs could be for city needs, as well as wholesale revenue opportunities in the event of regulatory changes requiring city to open its network to other providers, this should be considered as a future revenue stream, but not contemplated in this model. Placing additional conduit provides for the city to preserve surface streets by avoiding disruption to street infrastructure at a later date. See Table 2 – City of Fort Bragg Conduit Footage.

See Table 2 – City of Fort Bragg Conduit Footage

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

City of Fort Bragg Conduit Footage						
AREA	PARCEL	CENTERLINE	CROSSING	Total Route Footage	% Adjustment for Vertical Drill & Excess	Overall Estimated Fiber Route Footage
DA 01	299	18,498	1,595	20,093	10%	22,102.30
DA 02	240	6,929	869	7,798	10%	8,577.80
DA 03	223	12,185	1,694	13,879	10%	15,266.90
DA 04	375	10,998	1,808	12,806	10%	14,086.60
DA 05	257	10,224	878	11,102	10%	12,212.20
DA 06	380	15,797	1,094	16,891	10%	18,580.10
DA 07	359	20,209	1,102	21,311	10%	23,442.10
DA 08	342	19,654	884	20,538	10%	22,591.80
DA 09	179	18,136	784	18,920	10%	20,812.00
Total	2,654	132,630	10,708	143,338		157,671.80

PASSIVE MATERIALS:

During the placement of conduit there is five different types of passive material placed that complete the infrastructure, they are: 1) Passive Cabinets, 2) Main Service Terminals/Fiber Service Terminals, 3) Hand-Holes, 4) Splice Cases, and 5) Tethers. Hand-Holes are used to connect each structure (home or business location) with the main conduit/fiber infrastructure, typically from 1-4 connections per Hand-Hole. A Tether is the section of cable that do not having physical splice. See Table 3 – City of Fort Bragg Passive Material and Counts.

Table 3 – City of Fort Bragg Passive Material and Counts

City of Fort Bragg Passive Materials and Counts						
DA NO.	CABINET LOCATION	PST/CABINET	MST/FST	HH COUNT	SPLICE	TETHER
DA1	39.451748, -123.805705	864 CABINET	74	123	6	4
DA2	39.445609, -123.803831	864 CABINET	49	86	2	6
DA3	39.448146, -123.805130	864 CABINET	80	144	5	8
DA4	39.443062, -123.804286	864 CABINET	86	176	4	9
DA5	39.442897, -123.794394	864 CABINET	86	147	2	10
DA6	39.438152, -123.800944	864 CABINET	115	217	4	10
DA7	39.439956, -123.788732	864 CABINET	115	203	7	13
DA8	39.434479, -123.801572	864 CABINET	90	173	4	7
DA9	39.428814, -123.804295	864 CABINET	35	79	4	7
		Totals	730	1348	38	74

FIBER SIZES:

Once conduit and other passive material is installed, fiber will be pulled into conduit. There are seven different sizes of cable ranging from 24 fiber count to 432 fiber count totaling 157,671.80 feet. All fiber is loose tube, cut to size. As with conduit, the fiber has a 10% increase to facilitate the unforeseen and provide for slack loops for future growth and maintenance issues. See Table 4 – City of Fort Bragg Fiber Size and Length.

Table 4 – City of Fort Bragg Fiber Size and Length

City of Fort Bragg Fiber Size and Length			
Fiber Cable Size	Fiber Cable Footage	% Adjustment for Slack	Overall Estimated Fiber Route Footage
24 Fiber	38,937	10%	42,830.70
48 Fiber	19,795	10%	21,774.50
72 Fiber	28,050	10%	30,855.00
144 Fiber	23,373	10%	25,710.30
216 Fiber	20,171	10%	22,188.10
288 Fiber	10,406	10%	11,446.60
432 Fiber	2,606	10%	2,866.60
Total Ft.	143,338		157,671.80

The total estimate for the outside plant infrastructure, which includes detailed engineering labor, construction material, and construction labor cost totals \$6,980,474.53; \$44.27 per foot/\$2630.17 per 2654 passing's. The breakdown of labor and material cost is depicted in Table 5 - Outside Plant Infrastructure Estimate below.

Table 5 Outside Plant Infrastructure estimate

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

Fort Bragg Last-Mile FTTH Network Design-Build Cost Estimate	OSP Network Engineering Labor Cost	OSP Network Construction Material Cost	OSP Network Construction Labor Cost	Overall OSP FTTP Network Engineering & Construction Cost
Total	\$ 260,158.47	\$1,087,892.22	\$ 5,632,424.84	\$ 6,980,475.53
Avg Cost / Foot	1.65	\$ 6.90	\$ 35.72	\$ 44.27
Avg Cost / Passing	\$ 98.03	\$ 409.91	\$ 2,122.24	\$ 2,630.17

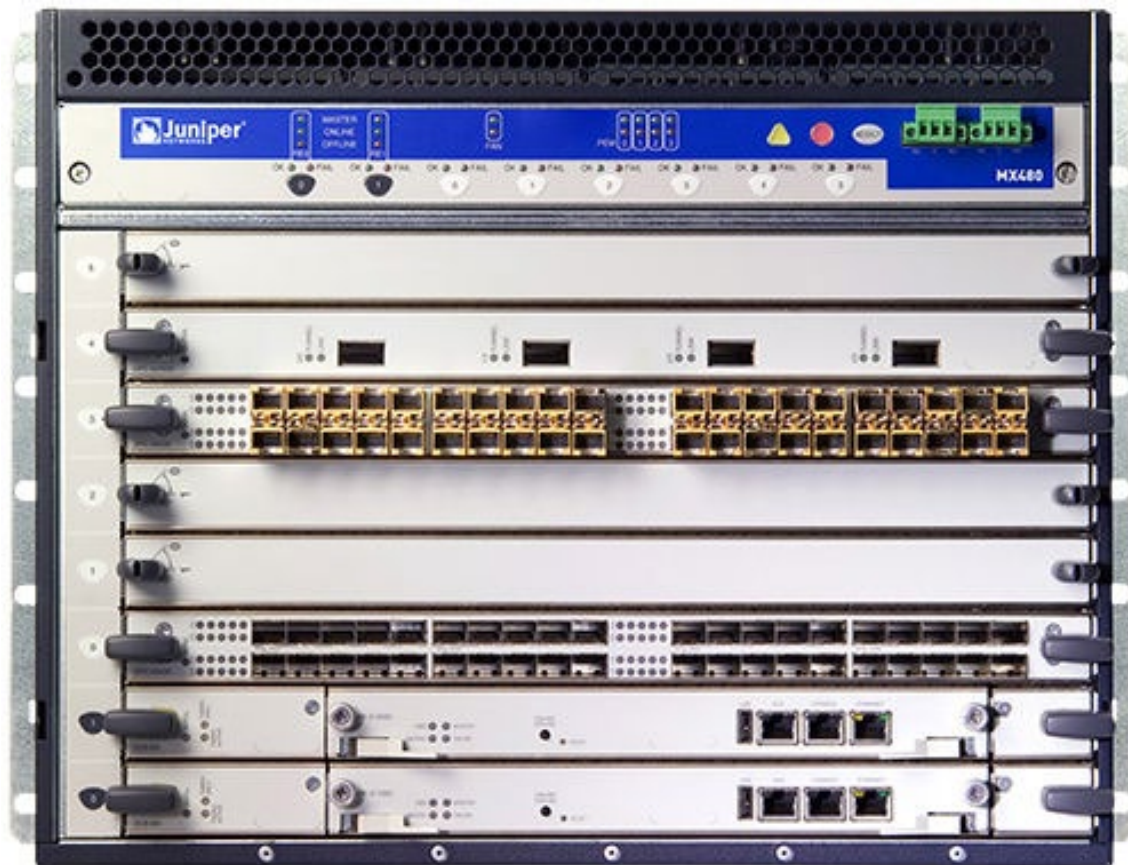
ELECTRONICS DESIGN

The electronics design incorporates three functions: 1) Core Routing, 2) Optical Line Termination (OLT), and 3) Optical Network Termination (ONT). Each of these functions provide the lighted path from the end-user to the Internet.

CORE ROUTING:

For this design, the team has specified Juniper core electronics equipment. Juniper has a several product lines and is a leader in core electronics space within the industry. The function of the core router is to take the aggregated signal from the OLT, provide IP addresses, and broadband gateway protocol (BGP), which allows for signals to be divided to one or more backhaul providers. Typically, BGP used to separate traffic to save backhaul by peering with Netflix, Amazon, Google. MCN has many years of experience using this product line has they currently use in their network and have approved the use of Juniper. See figure 6 for a view of the Juniper equipment.

Figure 6 – Juniper Router



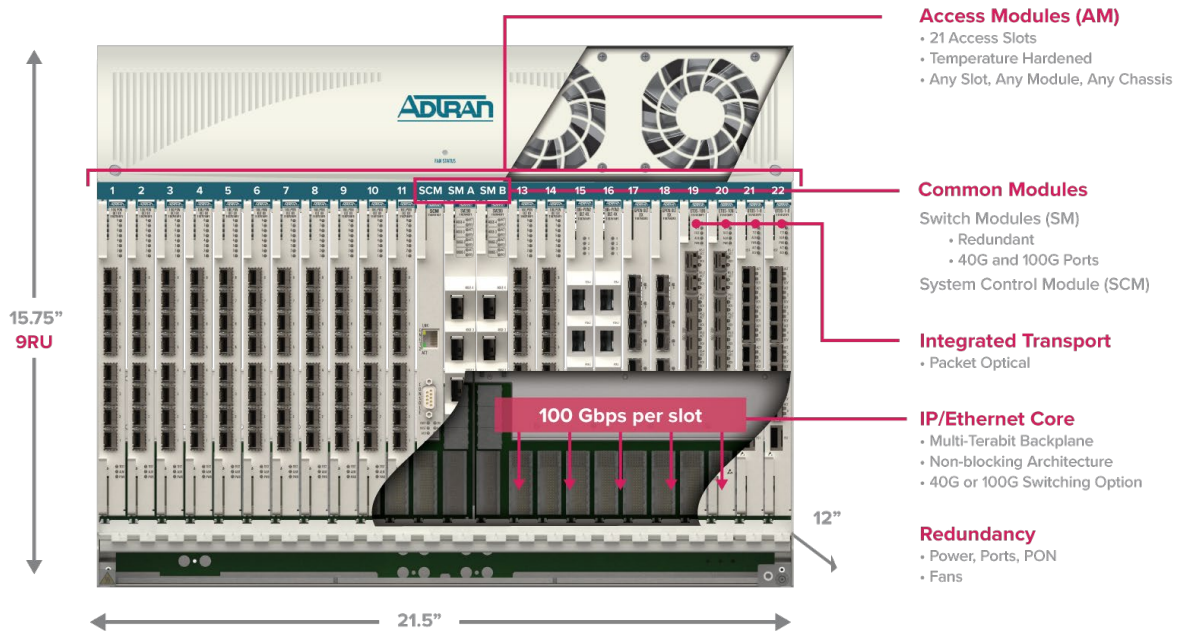
OPTICAL LINE TERMINATION:

The team has specified ADTRAN TA-5000 equipment as the provider for Optical Line Termination (OLT). The OLT is the electronics that serve end-user by providing light from Data Center through the fiber to the end-user location. The OLT provides the light at a 32:1 split ratio at up to 10Gbps speed per customer. The OLT also provides the service activation and port assignment for customer records and information systems. MCN has many years of experience

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

using this product line has they currently use in their network and have approved the use of ADTRAN. See Figure 7 for ADTRAN TA-5000 Equipment.

Figure 7 – ADTRAN TA-5000 Equipment



OPTICAL NETWORK TERMINATION:

The team has specified ADTRAN ONT's to be used at the end-user location. These devices turn the light received from the OLT into electrical signals to be used in the home. The ONT's come in various types/styles and will be decided during detail engineering and negotiations with MCN. MCN will have responsibility to install the ONT during end-user installation. Some ONT's come equipped with built in residential gateway functionality, which provides Wi-Fi 6, the latest in-home wireless specification.

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

Included below are both the indoor and outdoor versions of the ADTRAN ONT's and Residential Gateway's for Wi-Fi 6 throughout the home/business. See Figure 8 – Optical Network Terminal devices

Figure 8 – Optical Network Terminals



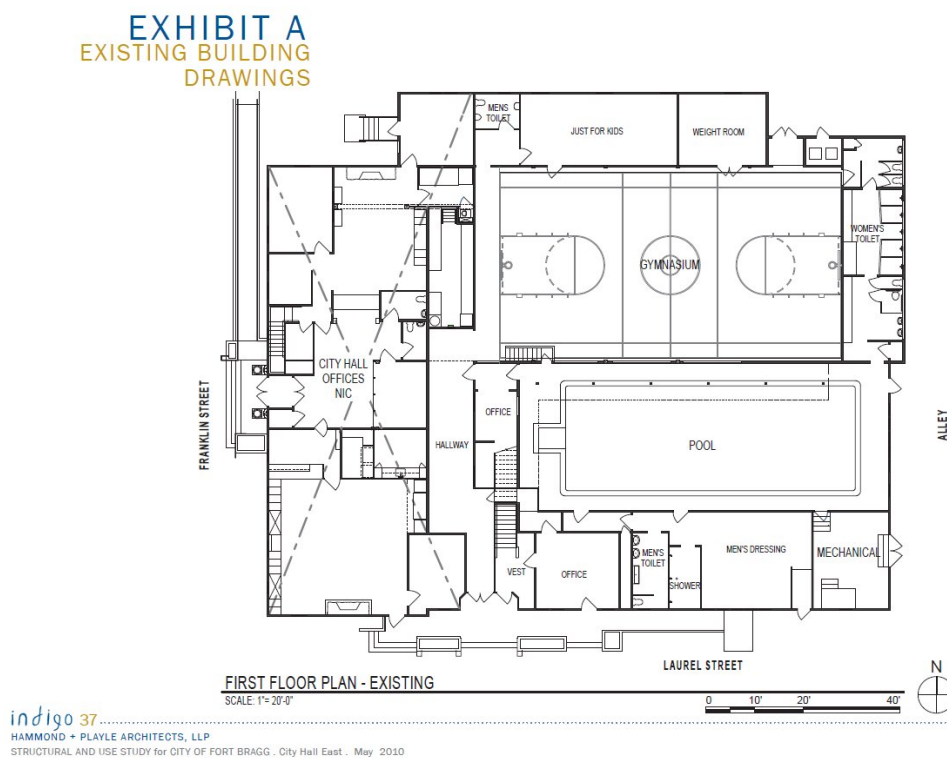
DATA CENTER:

The data center will require remodeling to support the electronics equipment that provide the Internet service. The location contemplated is at 416 N. Franklin St. in the current women's restroom area. Remodeling will consist of removal of all plumbing, and restroom stalls. Once removed it is recommended this location be designed for level 4 earthquake bracing, which will include 2x6 boards anchored to the walls, with data center ironwork and equipment relay racks installed and adequately anchored to the floor. A 4-ohm or less ground bar will need to be connected to the building master ground bar (may already exist), and fire suppression equipment (not water sprinklers) will be installed. Lastly, there will be a need to install several conduit entrance paths to facilitate outside fiber cables, both distribution and backhaul

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

conduits. An electrical panel with breakers will be placed in the equipment room for A/C distribution. The existing backup generator is more than sufficient to provide power, it is recommended a transfer switch between main A/C and electronics power supply be installed. For the purpose of this study, we have estimated \$100,000.00 for the cost to remodel and prepare the data center for electronics and supporting equipment. Actual cost for the data center to be determined following detailed project engineering. See Figure 9 for proposed data center location at 416 Franklin Street.

Figure 9 – Data Center Locations



The total estimate for the core network, optical electronics, and data center totals \$738,122.57; The average cost per foot is \$6.54, \$257.73 per 4000 subs, and is depicted in Table 6 -Core Network, Optical Electronics, and Data Center Prep Estimate below.

Table 6 - Core Network, Optical Electronics, and Data Center Prep Estimate

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

Fort Bragg Core Router Network, Data Center Prep, and OLT XGS-PON Network Design-Build Cost Estimate	ISP Juniper Core Router	ISP Data Center Prep	ISP OLT XGS-PON Ports & Lasers	Overall ISP Core Router Network, Data Center Prep, and OLT XGS- PON Design- Build Estimate
Total	\$ 457,806.40	\$ 280,316.17	\$ 292,797.99	\$ 1,030,920.56
Avg Cost / Foot	\$ 2.90	\$ 1.78	\$ 1.86	\$ 6.54
Avg Cost / Passing	\$ 114.45	\$ 70.08	\$ 73.20	\$ 257.73

SUBSCRIBER ACQUISITION (DROPS AND CPE EQUIPMENT):

Material and labor costs for placement of double ended connectorized drop from MST port in Pedestal/Flower Pot to CPE Network Interface Drop (NID) via underground placement at depth greater than or equal to 12 inches and install through up to 4ft outdoor conduit to outdoor ONT (Outdoor Network Termination); conduit is used to protect fiber from yard tools. Drop includes 2 ft slack coil at each end, restoration of route path to at least previous condition. Includes up to 50ft placement under driveway, sidewalk, or other landscaping, concrete or asphalt surfaces. The total estimate for subscriber acquisition is \$3,789,680; \$24 per foot/\$947.42 per 4000 subs. See Table 7 -Subscriber Acquisition Cost Estimate.

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

Table 7_- Subscriber Acquisition Cost Estimate

Fort Bragg Subscriber Acquisition Cost Estimate	Subscriber Acquisition Material Cost (Drop & CPE)	Subscriber Acquisition Labor Cost (Drop & CPE)	Overall Subscriber Acquisition (Drop and CPE) Overall Cost
Total	2,309,680	\$ 1,480,000.00	\$ 3,789,680.00
Avg Cost / Foot	\$ 14.65	\$ 9.39	\$ 24.04
Avg Cost / Passing	\$ 577.42	\$ 370.00	\$ 947.42

PROJECT MANAGEMENT:

A project of this size will require a project management office (PMO) to manage the undertaking. With that said, the city may have the existing resources to manage this project; extending the existing resources would be to your advantage as the people and processes exist, it is just a matter of adding workload to your city team. For the purpose of this analysis, we are including the cost of a separate PMO entity. The roles within this entity are project managers, construction inspectors, and accounting; typically, there is a legal component to this project, but we are assuming all contracts involved would be administered by current city staff.

Assumptions - PM hired full-time for 3years; Inspectors and Accountants employees stay until completion of base infrastructure, 25 weeks estimated. Have extended 5 additional weeks to close-out initial base infrastructure paperwork, completion of drawings, and recording of

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

assets. At completion of base infrastructure, assumption is city can take over the day-to-day operation of overseeing drop and ONT installs (5.5 per day). The dollars for installs are in capital budget; as an option, you can pay MCN for this work, hire new city staff, or leverage existing staff. Would recommend city consider hiring the PM as a fulltime employee during the construction and to manage the MCN service provider contract; PM would be MCN's single point of contact within the city. See Table 8 - PMP Office.

Table 8 - PMO Office

PMO Office	Annual Salary	Hourly Rate	Weekly rate	Year 1 (25 weeks)	Year 2 (50 weeks)	Year 3 (50 weeks)	Total
Project Manager	\$ 100,000.00	\$ 48.08	\$ 1,923.08	\$ 48,076.92	\$ 96,153.85	\$ 96,153.85	\$ 240,384.62
Inspector 1	\$ 90,000.00	\$ 43.27	\$ 1,730.77	\$ 43,269.23			\$ 43,269.23
Inspector 2	\$ 90,000.00	\$ 43.27	\$ 1,730.77	\$ 43,269.23			\$ 43,269.23
Accounting	\$ 60,000.00	\$ 28.85	\$ 1,153.85	\$ 28,846.15			\$ 28,846.15
	\$ 340,000.00			\$ 163,461.54	\$ 96,153.85	\$ 96,153.85	\$ 355,769.23

Total Fort Bragg Design and Build Estimate:

The total costs for the entire network infrastructure at 100% take rate (full utility model) which includes all three components for underground fiber/conduit and passive materials, Data Center prep, Core electronics, XGS-PON Optical Line Termination, Drops, and ONT is listed in Table 9.

Table 9 – Total Network Cost

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

Fort Bragg Last-Mile FTTH Network Design-Build Estimated Cost	Overall OSP FTTP Network Engineering & Construction Estimated Cost	Overall ISP Core Router Network, Data Center Prep, and OLT XGS-PON Design-Build Estimated Cost	Overall Subscriber Acquisition (Drop and CPE) Overall Estimated Cost	Project Management Office (PMO) Estimated Cost	Overall Total Network Estimated Cost
Total	\$ 6,980,475.53	\$ 1,030,920.56	\$ 3,789,680.00	\$ 355,769.23	\$12,156,845.32
Avg Cost / Foot	\$ 44.27	\$ 6.54	\$ 24.04	\$ 2.26	\$ 77.10
Avg Cost / Passing	\$ 2,630.17	\$ 257.73	\$ 947.42	\$ 88.94	\$ 3,039.21

Table 10 below shows the annual spend for 100% take rate and includes FTTP infrastructure, electronics and data center, and drops/CPE. This would be the entire amount at 100% of city build.

Table 10 – 3 Year Estimated Cost at 100% Take Rate

Overall Total Network Cost	Overall Total Year 1 Estimated Costs	Overall Total Year 2 Estimated Costs	Overall Total Year 3 Estimated Costs
\$12,156,845.32	\$ 9,630,391.98	\$ 1,263,226.67	\$1,263,226.67
\$ 77.10			
\$ 3,039.21			

CONSTRUCTION SCHEDULE

The construction schedule at this juncture should remain open until a final decision has been made as well as how much annually the city decides to spend on the infrastructure. For example, if the city wants to delay build over several years the schedule would be extended.

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

For the purpose of providing a timeline to the city on the amount of time it will take to build the base infrastructure, this study indicates 20 weeks using a two-crew approach; this approach is standard for most contractors. The timeline is based upon the number of available workdays in a week, number of crews, and the production footage per day in terms of feet of conduit/cable placed (800 ft.).

Other factors that impact the schedule are weather conditions, traffic control, material and labor availability. As a note to consider, under current economic conditions, material and labor are a concern, as is the amount of grant monies the current state and federal leaders are considering is enormous. Additionally, material and labor shortages are impacting telecommunications industry as a result of the pandemic and the mount of projects around the country. The recommendation is for the city to decide and then get into material/labor ques as soon as possible. The industry faced this challenge back in 2010 during the ARRA Projects, but quickly increased factory output and ended up being managed with slight project delays. See Table 10 – Construction Schedule (estimated).

Table 10 – Construction Schedule (estimated)

OSP Construction Schedule (estimated)				
Allowed Workdays Per Week	UG Production Per Crew Per Week	Qty of UG Crews	Overall Weekly UG Production	Estimated Construction Weeks
5	800	2	8000	20

NETWORK OPERATOR/SERVICE PROVIDER DEFINED

MCN is being considered for the role of service provider. MCN has a long relationship with the City of Fort Bragg and surrounding areas. The Mendocino Community Network (MCN) is a business owned and operated by the Mendocino Unified School District. MCN mission is to provide high-quality Internet services to the school district, customers, and the communities they serve. MCN has been providing internet in the community for over 25 years. In the early

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

days MCN provided dialup to over 8000 customers in Mendocino County and across the country. Currently MCN offers DSL internet and POTS (plain old telephone service) service to over 1000 customers in Fort Bragg as well as Fixed Wireless and VOIP telephone services. MCN registers and hosts over 1000 domains, websites and more than 4000 email accounts. MCN currently has eight full time employees and one part time employee.

MCN was created from the school district to provide much needed Internet service to students. Since its beginning, MCN has significantly expanded service locations, and offers a wide range of services beyond basic Internet connectivity. MCN offers affordable speed and pricing tiers for Internet, and voice services.

During this analysis MCN, specifically Sage Stathe, who we consider fully qualified, was asked to participate with providing background information necessary to determine if they are a valuable resource to facilitate City digital infrastructure plan and rollout. Below is a list of inputs received from MCN:

- **Ability to scale resources** – MCN expects some incremental increases and will depend on the take rate, and speed of construction.
- **Detailed plan on service activation and service assurance functions** – MCN currently offers regular tech support during 9AM-6PM Monday through Friday. They have a technician on call 24-7 that can start trouble tickets, trouble shoot Internet and voice issues, and forward calls to secondary technical teams as needed. MCN an internal tracking system for monitoring orders, trouble tickets and dispatches. The Manager and Insider Operations Manager handle sales and marketing (technicians in the field are salespeople by association). MCN promotes via radio, newspaper, social media, MTA Bus Ad, Our website, and MCN Email Mailing List.
- **Backhaul** – MCN currently provides backhaul services to their existing customer, have plenty of experience to provide backhaul to city network.
- **Outside Plant Design (OSP) and Electronics Equipment** – MCN has agreed to the design criteria of a 32:1 fiber split, as well as using Juniper Routers with dual 40 Gbps uplinks, and ADTRAN T5000 Optical Line Terminal product configured with XGSPON (10 Gbps).
- **Data Center Location** - MCN has agreed to all electronic equipment to be located at city office at 416 N. Franklin St. MCN will require complete access to the network equipment provided by the city in order to serve customers.
- **IP Addresses** – MCN has a /32 of IPv6, more than sufficient for this project. MCN currently has a /20 IPv4 addresses and have adequate addresses to provide Network Address Translation (NAT) of public IP's and static IP's addresses for customers who request them

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

(currently using 86 static IP's in all of Fort Bragg). MCN does not have enough IPv4 to assign a public IP to every home; this would only come into play if we were designing and all active Ethernet network, of which we are not proposing this type of design.

- **MCN Service Offering** - Basic Internet at three speed/price tiers (to be negotiated), Video, and Voice services. MCN confirmed the ADTRAN ONT plus Wi-Fi 6 Wireless Gateway, four ethernet ports, with two Voice ports located at the home/business will support their offerings.
- **Inside Wire** – MCN will facilitate service activation/assurance from the ONT demark on the side of the home and will facilitate all in home/business wiring necessary to make operational. The city will be responsible for OSP fiber maintenance, underground fiber restoration, cable locates, and Data Center maintenance and utilities, of which some of these functions can be provided by MCN.

PRO-FORMA

The pro-forma will identify three-line items for revenue: 1) Residential Fee, and 2) Commercial Fee, and Large Commercial Fee. As project evolves, there could be other forms of revenue such as MCN providing services to Cell Providers, and WISP's. In addition to the revenue, there will be expense line items for network infrastructure management; costs the city will incur as the network owner. Pro-forma also shows the capex required for the project and is identified into three parts parts: 1) initial infrastructure placement (fiber and electronics), 2) ongoing drop and CPE placement, and 3) electronics refresh in year 8 (electronics require a refresh every eight years). The city will need to decide if they want to deploy a 100% connectivity (utility model) to

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

every premise, or not; for the purpose of this study, we are showing a conservative 60% take rate.

It is up to the city to determine how they fund this network, this can be accomplished with cash, or debt through the use of bonds, available grant funds (state and or federal), or combination of all three. The model shows an example of debt for your analysis. When the city moves forward, debt structure will need to be determined.

REVENUE ASSUMPTIONS (60% TAKE RATE)

Revenue will be received from MCN who will provide city a per customer, per type of service fee for the use of the infrastructure. The amount of fee is to be agreed upon between city and MCN through negotiations process contemplating infrastructure cost, annual maintenance, and oversight cost. The result must balance both city and MCN's needs. For the city, you will require fee's that provides for an acceptable fee that covers all expenses, and debt at a minimum. MCN needs to be able to sustain their business with some level of profit. For the purpose of this analysis a monthly fee is as follows: 1) Residential \$50.00 for 1 Gbps, Small Commercial \$150.00 for 1 Gbps, and Large Commercial \$230.00 for 5-10 Gbps; all speed and price tiers to be determined between city and MCN.

Annual revenue at steady state in year-4 is \$2,260,020

EXPENSE ASSUMPTIONS (60% TAKE RATE)

The city, as the network owner will have minimal OG's and operating expenses for the day-to-day business. The expenses will be consistent with the level of involvement the city desires. The city can choose to outsource much of the responsibility to MCN or others as desired. At a minimum the recommendation is to leverage existing staff to oversee the business. Since the actual service will be handled by MCN (service Provider), the city should have a broadband liaison to oversee monthly results both in through a service and financial audit process. Additionally, the recommendation is for the city to utilize existing staff and heavy equipment for infrastructure damage restoration.

The model contemplates COG's and Operating Expenses. There are four categories in COG's – 1) Electricity Cost for Data Center, 2) Cable Locates, 3) OSP Maintenance, and 4) Network Owner Broadband Manager. The assumption is to hire Project Manager during the build, while transitioning to the role of Network Owner Broadband Manager following initial build beginning in year four. Operating Expenses consist of two categories – 1) Internet Expense Savings, and 2) Professional Fees.

COGS:

- 1) Annual Electricity - \$6,000
- 2) Annual Cable Locates - \$7,200
- 3) Annual OSP Maintenance - \$12,000
- 4) Annual Network Owner Broadband Manager - \$120,000

Annual COG's at steady state in year-5 is \$145,200

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

Operating Expense:

- 1) Annual Internet Savings – (\$6,000) Note: assumed city Internet/Telephone to be free
- 2) Annual Professional Fee's - \$12,000

Gross Profit at steady state in year-5 is \$2,174,820

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

10-YEAR INCOME STATEMENT:

CITY of FORT BRAGG							
PRO FORMA INCOME STATEMENTS, ANNUAL							
60% Take Rate Model							
	Y1	Y2	Y3	Y4	Y5	Y10	
Revenue							
Fiber asset fee (speed and price tbd))	225,750	636,300	1,029,600	1,132,200	1,132,200	1,132,200	
Fiber asset fee (bus. speed and price tbd)	451,500	1,067,400	1,101,600	1,101,600	1,101,600	1,101,600	
10 Gbps (Large Businesses/gamers)	20,114	26,220	26,220	26,220	26,220	26,220	
- Static IP	-	-	-	-	-	-	
- Multi-Gig Routing	-	-	-	-	-	-	
- Whole Home Wi-Fi	-	-	-	-	-	-	
- Other	-	-	-	-	-	-	
Total Revenue	697,364	1,729,920	2,157,420	2,260,020	2,260,020	2,260,020	
Cost of Goods Sold							
- Telecommunications Backhaul	-	-	-	-	-	-	
- Net Fabric	-	-	-	-	-	-	
- Alianza VoIP	-	-	-	-	-	-	
- Electricity at 416 Franklin St.	6,000	6,000	6,000	6,000	6,000	6,000	
- Cable Locates	7,200	7,200	7,200	7,200	7,200	7,200	
- OSP Maintenance	12,000	12,000	12,000	12,000	12,000	12,000	
- Customer/Technical Support	-	-	-	-	-	-	
- Installation & Repair Technicians	-	-	-	-	-	-	
- Network Technicians	-	-	-	-	-	-	
Project Manager (first 3 years Capitalized)	-	-	-	60,000	120,000	120,000	
- Technician Vehicle Expense	-	-	-	-	-	-	
- Billing and Back Office Systems	-	-	-	-	-	-	
- Developer or Mineral Rights Fee	-	-	-	-	-	-	
Total Cost of Goods Sold	25,200	25,200	25,200	85,200	145,200	145,200	
Gross Profit	672,164	1,704,720	2,132,220	2,174,820	2,114,820	2,114,820	
Operating Expenses							
- Advertising and Promotion	-	-	-	-	-	-	
- Auto Expenses	-	-	-	-	-	-	
- Rent	-	-	-	-	-	-	
- Telephone	-	-	-	-	-	-	
- Internet (free svc. from MCN)	(72,000)	(72,000)	(72,000)	(72,000)	(72,000)	(72,000)	
- Office Supplies	-	-	-	-	-	-	
- Professional Fees	12,000	12,000	12,000	12,000	12,000	12,000	
- Miscellaneous	-	-	-	-	-	-	
Total Expenses	(60,000)	(60,000)	(60,000)	(60,000)	(60,000)	(60,000)	
Operating Profit	732,164	1,764,720	2,192,220	2,234,820	2,174,820	2,174,820	
Interest	294,932	299,418	289,312	274,727	261,807	190,968	
Taxes	-	-	-	-	-	-	
Depreciation and Amortization	694,548	875,008	875,008	875,008	875,008	452,596	
- Subtotal	989,480	1,174,426	1,164,320	1,149,735	1,136,815	643,563	
Pre-tax Profit (Loss)	(257,316)	590,294	1,027,900	1,085,085	1,038,005	1,531,257	
EBITDA	732,164	1,764,720	2,192,220	2,234,820	2,174,820	2,174,820	

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

10-YEAR CASH FLOW STATEMENT:

CITY of FORT BRAGG							
PRO FORMA CASH FLOW STATEMENTS, ANNUAL							
60% Take Rate Model							
	Y1	Y2	Y3	Y4	Y5	Y10	
Receipts							
- Collections	697,364	1,729,920	2,157,420	2,260,020	2,260,020	2,260,020	
- Investment	-	-	-	-	-	-	
- Loans	10,000,000	400,000	-	-	-	-	
Total Receipts	10,697,364	2,129,920	2,157,420	2,260,020	2,260,020	2,260,020	
Disbursements							
- Cost of Goods Sold	25,200	25,200	25,200	85,200	145,200	145,200	
- Advertising and Promotion	-	-	-	-	-	-	
- Auto Expenses	-	-	-	-	-	-	
- Rent	-	-	-	-	-	-	
- Telephone	-	-	-	-	-	-	
- Internet (free svc. from MCN)	(66,000)	(72,000)	(72,000)	(72,000)	(72,000)	(72,000)	
- Office Supplies	-	-	-	-	-	-	
- Professional Fees	11,000	12,000	12,000	12,000	12,000	12,000	
- Miscellaneous	-	-	-	-	-	-	
- Franchise Taxes/Other Taxes	-	-	-	-	-	-	
- Interest	294,932	299,418	287,260	274,727	261,807	190,968	
- Principal Repayment	370,585	395,186	407,344	419,877	432,797	503,637	
- Capital Expenditures	9,630,392	1,263,223	-	-	-	-	
- Distributions	-	-	-	-	-	-	
- Working Capital	-	-	-	-	-	-	
Total Disbursements	10,266,109	1,923,027	659,804	719,804	779,804	779,804	
Net Cash Flow	431,254	206,893	1,497,616	1,540,216	1,480,216	1,480,216	
Beginning Balance	-	431,254	638,148	2,135,763	3,675,979	10,476,574	
Ending Balance	431,254	638,148	2,135,763	3,675,979	5,156,195	11,956,790	

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

10-YEAR BALANCE SHEET STATEMENT

CITY of FORT BRAGG							
PRO FORMA BALANCE SHEET STATEMENTS, ANNUAL							
60% Take Rate Model							
	Y1	Y2	Y3	Y4	Y5	Y10	
Current Assets							
- Cash	431,254	638,148	2,135,763	3,675,979	5,156,195	11,956,790	
- Accounts Receivable	-	-	-	-	-	-	
- Prepaids	-	-	-	-	-	-	
- Other Current Assets	-	-	-	-	-	-	
Total Current Assets	431,254	638,148	2,135,763	3,675,979	5,156,195	11,956,790	
Fixed Assets							
- Capital Equipment	9,630,392	10,893,615	10,893,615	10,893,615	10,893,615	11,494,099	
- Accumulated Depreciation	(694,548)	(1,569,555)	(2,444,563)	(3,319,571)	(4,194,579)	(7,482,843)	
Total Fixed Assets	8,935,844	9,324,059	8,449,051	7,574,043	6,699,035	4,011,256	
Total Assets	9,367,099	9,962,207	10,584,815	11,250,022	11,855,230	15,968,046	
Current Liabilities							
- Accounts Payable	(5,000)	(5,000)	(5,000)	(5,000)	(5,000)	(5,000)	
- Line of Credit	-	-	-	-	-	-	
- Other Current Liabilities	-	-	-	-	-	-	
Total Current Liabilities	(5,000)	(5,000)	(5,000)	(5,000)	(5,000)	(5,000)	
Long-Term Liabilities							
- Loans Payable	9,629,415	9,634,228	9,226,884	8,807,007	8,374,210	6,002,015	
Total Long-Term Liabilities	9,629,415	9,634,228	9,226,884	8,807,007	8,374,210	6,002,015	
Total Liabilities	9,624,415	9,629,228	9,221,884	8,802,007	8,369,210	5,997,015	
Equity							
- Paid-In Capital	-	-	-	-	-	-	
- Distributions	-	-	-	-	-	-	
- Retained Earnings	(257,316)	332,978	1,362,930	2,448,015	3,486,020	9,971,031	
Total Equity	(257,316)	332,978	1,362,930	2,448,015	3,486,020	9,971,031	
Liabilities + Equity	9,367,099	9,962,207	10,584,815	11,250,022	11,855,230	15,968,046	

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

Thank you for the support and assistance we have received from individuals and entities across Fort Bragg in developing this project to further implement ***City of Fort Bragg Digital Infrastructure Plan: 2021-2025.***

APPENDIX

RECOMMENDED VENDORS TO USE FOLLOWING DECISION TO PROCEED:

Walker & Associates for electronics equipment, OSP material, data center Prep. Using a single vendor that supports the entire infrastructure is vital, if not you will have to establish vendor relationships with many different material providers.

ADTRAN is available through Walker & Associates, but suggest you establish a direct relationship so you can stay current on technologies, equipment hardware and software releases.; Walker & Associates will arrange for this automatically.

PalniES provided the OSP design and recommend you use them for the detailed design as this will save OSP detailed engineering charges as PalniES already has most of the design data. PalniES is a full service OSP design and engineering company capable of taking your project from cradle to grave.

FUTURE TECHNOLOGIES

There are several new technologies available now to allow you to better serve Fort Bragg; this study provides the estimated cost of the infrastructure to place underground fiber and electronics throughout the city. When and if you progress with this project, I encourage you to look at some of these technologies in your initial deployment; they include the following:

New light pole technologies that allow for multiple uses, such as 5G/LTE, security cameras, digital signage, and several sensors (air quality, motion, soil)

Electrical vehicle charging stations will most likely be required by government between now and 2035 per mandates. Vehicle charging stations offer more than just a battery recharge, they are now SMART devices that enable credit card usage, marketing signage boards, wayfinding maps, and more.

Public Wi-Fi is another technology you should consider at all public gathering points (parks, sports fields, beaches, marinas). There are several manufactures for public Wi-Fi equipment but recommend Juniper Mist product for it low cost, and ease of operation.

Venue Applications allows for the city or Chamber to better represent their members. A typical venue app is great for tourism as app allows for wayfinding, on-line access to stores and restaurants, purchase theater tickets, and more.

Digital signage or smart boards are the latest in technology for historical downtown areas, parks, hiking trails, etc.... these digital signage boards not only provide vital information, but also serve as a revenue stream by selling marketing and marketing data collected from the

public. Typical digital signage boards are QR Code driven, meaning users can scan the board and take whatever information they obtained with them as they tour the area.

RESPONSIBILITY MATRIX

The following responsibility matrix provides an example of how the city and MCN identify functions necessary to own and operate the network. As the project progresses, this matrix can provide the roadmap for negotiations between parties, which ultimately can be used in contractual agreements between city and MCN.

FORT BRAGG DIGITAL INFRASTRUCTURE PLAN 2021-2025 (FTTP PROJECT)

Responsibility Matrix			
	P = Primary	S = Secondary	X = Sole responsibility
	City	MCN	Notes:
Customer Care Center (Public Office)			
Hire GM		X	City should participate
Hire support staff	-	X	
Service offering packages	S	P	City should participate to ensure constituents are satisfied politically
Process Flows	S	P	City should participate as some issues could involve infrastructure
Terms and Conditions Agreement for service	S	P	City should participate to ensure constituents are satisfied politically
Managing Deposits		X	
Billing intervals/mailling, messaging on bills		X	
Daily cash drawers		X	
Office Space		X	City should participate
Building Access/Alarms		X	
Dispatch	S	P	City to have a role for major infrastructure repair
Order Intervals - Scheduling	S	P	City may have a role for service activation/assurance
Bank accounts		X	
Deposits		X	
OSP Operations			
Service Installation	-	X	
Hiring Staff	-	X	
Vehicles	-	X	
Tool Tracking/Management system	S	P	City will purchase a fiber records management system, MCN to keep current
Technician cell phones, laptops, HH devices	-	X	
Fiber Splicing tools (Fusion Splicer, Cleaver, OTDR, Power Meter)	-	X	City may hire MCN to manage all splicing needs
Inventory Tracking Process	-	X	May involve city, discuss with MCN/ City; city should have limited cable/material on hand
Technician Training	-	X	
Technician time reporting	-	X	
Plant maintenance	P	S	This is all infrastructure related
Plant records keeping	-	-	need to discuss how to keep fiber strand inventory
Safety program for OSP/Construction	X	X	A high priority for both parties as they will jointly restore infrastructure
Technician time reporting	S	P	City to follow current processes
After hours technical support for OSP		X	
After hours call out process	S	P	City to be in loop in the event infrastructure is damaged
Cut UG cable construction support	P	S	City to use heavy equipment to expose damaged cable, MCN to restore service (splicing)
Underground Service Alert	P	S	City could hire MCN for this function
Test and turn-up	-	X	
QA Acceptance	-	X	
Records Retention	S	P	Line extension related, need to discuss
Circuit Assignment	-	X	
Provisioning	-	X	
Change Order Requests Process	S	P	May involve city, discuss with MCN/ City
Change Order Scope/Pricing	S	P	May involve city, discuss with MCN/ City
Change Order Approval	P	S	May involve city, discuss with MCN/ City
Facilities Moves (Road moves/widening, pole moves, pole replacements)	S	P	May involve city, discuss with MCN/ City
Service reporting	-	X	May involve city, discuss with MCN/ City
Network Operations			
Network Assurance			
Network Monitoring	-	X	
Capacity Management (Backhaul)	-	X	
Fault Isolation	S	P	
SLA Performance Tracking/Reporting	S	P	
Network Dispatch	-	X	
Network Repair (including the network side of the ONT)	-	X	Non Infrastructure related
Service Assurance (Customer)			
Service Monitoring	-	X	
Capacity Management for downstream Internet Connections	-	X	
Network Fault Isolation	-	X	
SLA Performance Tracking/Reporting	-	X	
Service Dispatch	-	X	
Service Repair	-	X	
End-user Repair (Home/MDU/Commercial)	-	X	
Tier 1 Help Desk/ Call center	-	X	
Network Activation			
Network Service Orders	-	X	
TAC Center	-	X	
Tier 2 Help Desk (Network Device Management)	-	X	
Infrastructure Management			
Utility Joint Pole Attachments	X		Should be all Underground; however, there may be line extensions, need to discuss
Cable Locating Association Admin	P	S	City may already be involved in utility locates and should be responsible for infrastructure
Outside Plant Break / fix	P	S	
Break / fix splicing	P	S	MCN could be hired for splicing since they already have capabilities
Fixed Wireless Tower Attachments	P	S	Need to discuss
Data Center			
Access Control	P	S	Need to discuss
Monitoring and Managing Environmentals	P	S	
Managed Security (Antivirus, Vulnerability Scans)	P	S	
*****Each item to be thoroughly discussed, agreed upon, then memorialized into a service agreement between the City and MCN*****			